NOTES ON THE REPUGNATORIAL GLANDS OF CERTAIN NOTODONTID CATERPILLARS.

GLENN W. HERRICK and JOHN D. DETWILER.

In the course of a study which the writers are making of the life histories and habits of the red-humped apple caterpillar (*Schizura concinna*) and the yellow-necked caterpillar (*Datana ministra*), the junior author noted that while handling the caterpillars of the former species, especially when they were pinched with forceps, a considerable amount of moisture would suddenly appear in an area about the body of the larva as it lay in the hand or rested upon the table. Curiosity as to the source of the moisture was aroused and the following experiments were made by the writers to determine its origin, nature, and method of dispersion.

The presence of repugnatorial eversible glands in Notodontid caterpillars has been known since the time of DeGeer, and Packard* gives a list of nine species in which the glands have been found. *S. concinna* appears in the list and Packard remarks as follows concerning it.

"While examining the very gaily colored and heavily spined caterpillars of *Schizura concinna*, I observed that when a fully grown one was roughly seized with the forceps or fingers it sent out a shower of spray from each side of the prothoracic segment, exactly like that of *Cerura* and *Macrurocampa*." Several years previously a note from C. S. Denham† appeared in Insect Life in which he said that in rearing a brood of these caterpillars he "discovered that they had the power to emit quite a quantity of strong hydrochloric acid strong enough to be decidedly corrosive to the skin and easily perceptible in the atmosphere."

In investigating the source and nature of the moisture which appeared whenever the Schizura larvæ were handled at all roughly it soon became evident that these caterpillars possessed considerable amounts of the liquid and that they were able to eject it to a surprisingly long distance and over a comparatively large area. In determining the habits and behavior of the different individuals of *Schizura concinna* in ejecting the liquid

* Jr. N. Y. Ent. Soc., Vol. III, pp. 110–127, 1895.
† Insect Life, Vol. I, p. 143, 1888.

the caterpillars were placed on large sheets of blue litmus paper and were then irritated at different points on the body by pinching them with forceps. It was difficult to see the spray on account of its fine misty quality. Occasionally, by getting the caterpillar in just the right position between the observer and the rays of light, one could see a tiny jet or cloud of mist. The effect on litmus paper, however, was instantaneous and conspicuous, for every drop that touched the paper changed it to a characteristic red color. Moreover, the area covered by the spray and the distance to which it could be ejected were easily and accurately determined. The following experiments and observations on *S. concinna* illustrate the action of the glands.

A full-grown larva was carefully placed near the center of a large sheet of litmus paper. While in this position it was pinched with tweezers on the fifth abdominal segment. At once a fine invisible spray was thrown out around the body in a posterior direction. An area surrounding the body about 3 inches wide and 5 inches long was colored solidly red, while about the lateral and posterior borders of this solidly colored area was a field covered with drops of various sizes. From right to left the farthest drops were 5½ inches apart.

The larva was pinched again near the thorax, the main pressure being exerted on the right side of the body. There was an immediate spray toward the right and in a posterior direction. The farthest drop posteriorly was 7½ inches from the caudal end of the abdomen, while the farthest drop laterally was 5¼ inches from the body. Figure 1 shows the pattern of the spray on the litmus paper.

An attempt was made to determine the direction of the spray in relation to the point of irritation. When irritated on the right side and the head left free, the head is thrown to the right and the spray is directed largely to the right side of the body. When irritated on the left side the movement of the head is in that direction and the spray is directed mostly to the left. When irritated near the posterior end of the abdomen there is a decided tendency for the spray to be thrown in a posterior direction. When pinched just behind the hump on the second thoracic segment all of the secretion was projected backward and to the left. In case of this particularly vigorous larva the drops were thrown approximately 7 inches distant in a lateral direction from the head and in a posterior direction

to the distance of 7½ inches. Again the larva was touched lightly on the right side of the body. The head was immediately turned to the right whereupon a sudden pinch with forceps caused the liquid to be projected in a fine spray almost entirely on the right side of the body. In all, this larva was irritated seven distinct and successive times. It responded to each of the first six irritations by an ejection of liquid although in a lesser quantity toward the end, while no response was obtained from the seventh irritation. Evidently the supply became exhausted or the larva became fatigued and indifferent to the irritation.

Fig. 1. Spray pattern (½ size), reproduced from litmus paper, of one ejection of liquid by a vigorous larva. C, position of caterpillar.

Since the direction of the spray appeared to correspond to the direction in which the head was free to move we obtained a fresh larva and held the head so that there was practically no movement to the right or left. In response to stimulus under these conditions the larva was still able to throw a spray of the liquid to the distance of from 6 to 7 inches, but wholly in a posterior direction over the entire body. This experiment was repeated with another larva with similar results. It appears evident that the caterpillar can direct the liquid backward to a distance of several inches even though the head be prevented from free movement to the right or left. Moreover, experiments show that the larva can project the spray in an anterior direction.

The caterpillars under observation were too far advanced to determine whether the larvæ possess functional glands in all of the earlier instars. A late brood, however, was found in which the larvæ were in the next to the last instar. One of these larvæ, after what seemed to be a greater degree of irritation than usual, did eject a considerable quantity of the fluid, the farthest drop falling at a distance from the body of about 3¼ inches. We hope to be able, next season, to make further investigations of this phase of the subject.

The opening of the gland is a narrow transverse slit on the ventral side of the prothorax close to the cephalic border of this segment. The gland is sack-shaped and situated within the thoracic cavity. It appears to be quite similar to the corresponding gland in *Cerura vinula* described by Klemensiewicz.* Further detailed description of this gland and its morphology will be presented by the Junior author in a later paper.

Regarding the chemical nature of the secretion it is sufficient to say here that it gives a marked acid reaction with blue litmus paper and that it has a pungent and characteristic odor that immediately suggests acetic acid. The subject is under careful investigation in conjunction with Professor E. M. Chamot of the chemical department, the results of which will be given in a later paper. Suffice it to say, the investigations indicate that the secretion is formic acid. Poulton† has already shown that the secretions from the similar gland in *Cerura vinula* is formic

* Verhandlungen d. Zool. Bot. Gesellsch in Wien. Vol. 32, pp. 468–474, 1882.
† Trans. Lon. Ent., Soc. for 1886, p. 157.

acid. The effect of the fluid on the skin is such as to cause burning and itching similar to the effect of the common plant known as "nettles." However, this effect is not so noticeable unless the quantity falling on the hand is of considerable amount.

It is hoped that opportunity may be found next year for further observations and experiments on these glands in other members of the genus.

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